

EXHIBIT J

MAAP-011247-DIE
**Power Amplifier, 2 W
DC - 22 GHz**
Preliminary - Rev. V2P
Features

- High Gain: 13 dB
- P1dB: 30 dBm
- P_{SAT}: 33 dBm
- Output IP3: +42 dBm
- Bias Voltage: V_{DD} = 15 V
- Bias Current: I_{DSQ} = 500 mA
- 50 Ω Matched Input / Output
- Temperature Compensated Output Power Detector
- Die Size: 2.99 x 1.5 x 0.1 mm
- RoHS* Compliant

Description

The MAAP-011247-DIE is a 2 W distributed power amplifier offered as a bare die part. The power amplifier operates from DC to 22 GHz and provides 12 dB of linear gain and 33 dBm of saturated output power. The device is fully matched across the band and includes a temperature compensated output power detector

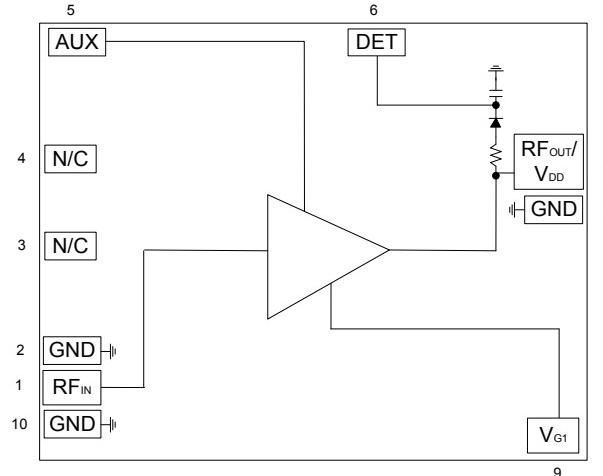
The MAAP-011247-DIE can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for test and measurement, EW, ECM, and radar applications.

This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information

| Part Number | Package |
|--------------------|----------------------|
| MAAP-011247-DIEPPR | Gel Pak ¹ |
| MAAP-011247-SMBPPR | Sample Board |

1. Die quantity varies

Functional Schematic

Pin Configuration²

| Pin No. | Pin Name | Description |
|---------|------------------------------------|---------------------------|
| 1 | RF _{IN} | RF Input |
| 2 | GND | Ground |
| 3 | N/C | No connection |
| 4 | N/C | No connection |
| 5 | AUX | Auxiliary |
| 6 | DET | Power detector |
| 7 | RF _{OUT} /V _{DD} | RF output / drain voltage |
| 8 | GND | Ground |
| 9 | V _{G1} | Gate voltage |
| 10 | GND | Ground |

2. Backside of die must be connected to RF, DC and thermal ground.

*Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

1

PRELIMINARY: Data Sheets contain information regarding a product MACOM has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

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DC-0011198

MAAP-011247-DIE
**Power Amplifier, 2 W
DC - 22 GHz**
Preliminary - Rev. V2P**Electrical Specifications: $T_A = +25^\circ\text{C}$, $V_{DD} = 15 \text{ V}$, $I_{DSQ}^3 = 500 \text{ mA}$, $Z_0 = 50 \Omega$**

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|----------------------------|----------------------------|-------|------|------|------|
| Gain | 2 GHz | dB | — | 12.0 | — |
| | 12 GHz | | | 12.5 | |
| | 18 GHz | | | 13.0 | |
| | 22 GHz | | | 13.0 | |
| P_{SAT} | 2 GHz | dBm | — | 34.5 | — |
| | 12 GHz | | | 34.5 | |
| | 18 GHz | | | 33.0 | |
| | 22 GHz ⁴ | | | 30.5 | |
| $P_{1\text{dB}}$ | 2 GHz | dBm | — | 31.5 | — |
| | 12 GHz | | | 32.0 | |
| | 18 GHz | | | 30.0 | |
| | 22 GHz | | | 29.5 | |
| OIP3 | 2 GHz | dBm | — | 45.5 | — |
| | 12 GHz | | | 45.5 | |
| | 18 GHz | | | 42.0 | |
| | 22 GHz | | | 41.0 | |
| PAE | 2 GHz | % | — | 23.0 | — |
| | 12 GHz | | | 20.0 | |
| | 18 GHz | | | 18.5 | |
| | 22 GHz | | | 13.5 | |
| $P_{IN} = +23 \text{ dBm}$ | | | | | |
| Input Return Loss | $P_{IN} = -20 \text{ dBm}$ | dB | — | 15 | — |
| Output Return Loss | $P_{IN} = -20 \text{ dBm}$ | dB | — | 15 | — |
| I_{DD} (with RF drive) | $P_{IN} = +23 \text{ dBm}$ | mA | — | 600 | — |
| I_{G1} | — | mA | — | 8 | — |

3. Set I_{DSQ} according to bias procedures in page 4.4. $P_{IN} = 20 \text{ dBm}$ to maintain 3 dB or less of compression.**Maximum Operating Ratings**

| Parameter | Rating |
|-------------------------------------|----------------|
| Input Power | 23 dBm |
| Junction Temperature ^{5,6} | +150°C |
| Operating Temperature | -40°C to +85°C |

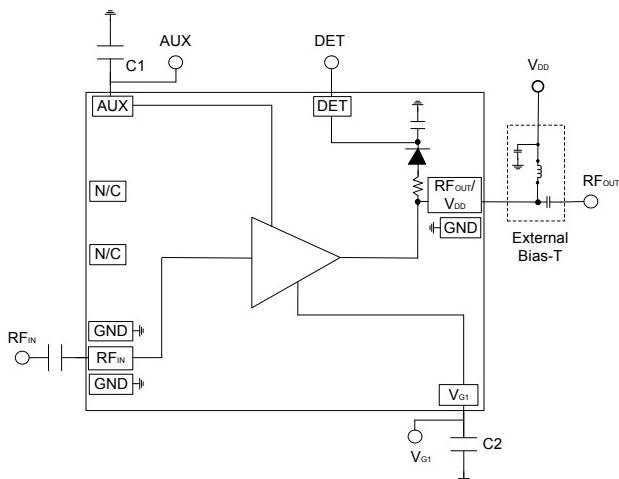
5. Operating at nominal conditions with junction temperature $\leq +150^\circ\text{C}$ will ensure MTTF $> 1 \times 10^6$ hours.
6. Junction Temperature (T_J) = $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$
 Typical thermal resistance (Θ_{JC}) = 6.5 °C/W.
 a) For $T_C = +85^\circ\text{C}$,
 $T_J = +134^\circ\text{C}$ @ 15 V, 0.62 A, $P_{OUT} = 33 \text{ dBm}$, $P_{IN} = 23 \text{ dBm}$

Absolute Maximum Ratings^{7,8}

| Parameter | Absolute Maximum |
|-----------------------------------|------------------|
| Input Power | 28 dBm |
| Drain Voltage | +16 V |
| Gate Voltage | -5 to 0 V |
| Junction Temperature ⁹ | +175°C |
| Storage Temperature | -65°C to +125°C |

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

Preliminary Information

MAAP-011247-DIE**MACOM™**
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Preliminary - Rev. V2P**Application Schematic****Bill of Materials^{10,11,12}**

| Part | Value | Size | Comment |
|--------|-----------|------|---------|
| C1, C2 | 1 μ F | 0402 | bypass |

10. C1 & C2 are required for operation below 1 GHz.
 11. High power external bias tee was used for measurements.
 12. External DC block was used on input.

Biasing Conditions

Recommended biasing conditions are $V_{DD} = 15$ V, $I_{DSQ} = 500$ mA (controlled with V_{G1}).

V_{DD} Bias must be applied through a resonant free high inductance on the RF output line.

By-pass capacitor C1 for the auxiliary pad is for a low frequency operation extension (below 1 GHz).

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

Recommended PCB Information

RF input and output are 50Ω transmission lines. Single layer 8 mil Rogers RO4008 with 1/2 oz. Cu. Use copper filled vias under ground paddle.

Grounding

It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200- μ m) diameter vias under the device, assuming an 8-mil (200- μ m) thick RF layer to ground.

Operating the MAAP-011247**Turn-on**

1. Apply V_{G1} (-4.5 V).
2. Increase V_{DD} to 15 V.
3. Set I_{DSQ} by adjusting V_{G1} more positive (typically -3.4 V for $I_{DSQ} = 500$ mA).
4. Apply RF_{IN} signal.

Turn-off

1. Remove RF_{IN} signal.
2. Decrease V_{G1} to -4.5 V.
3. Decrease V_{DD} to 0 V.

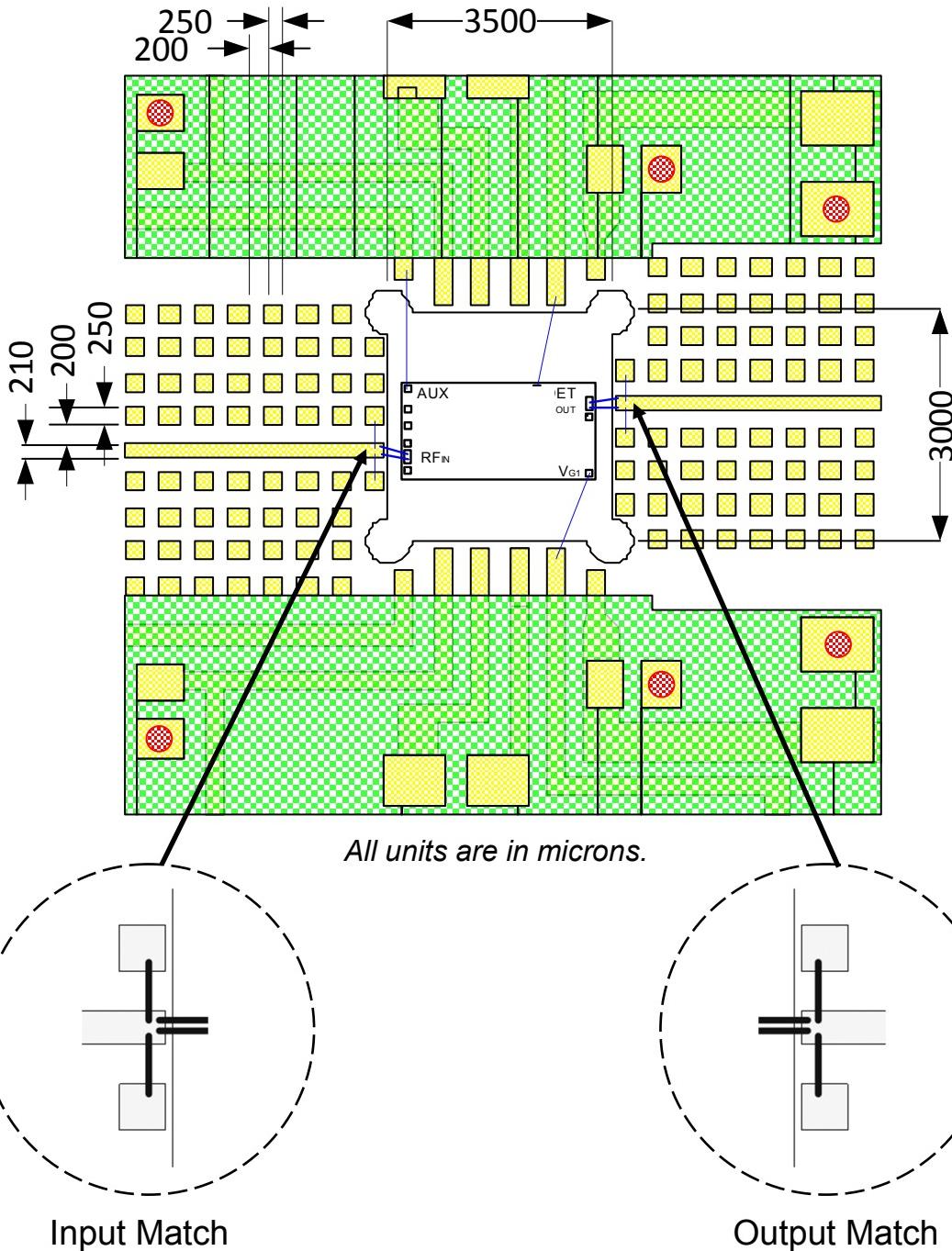
Preliminary Information

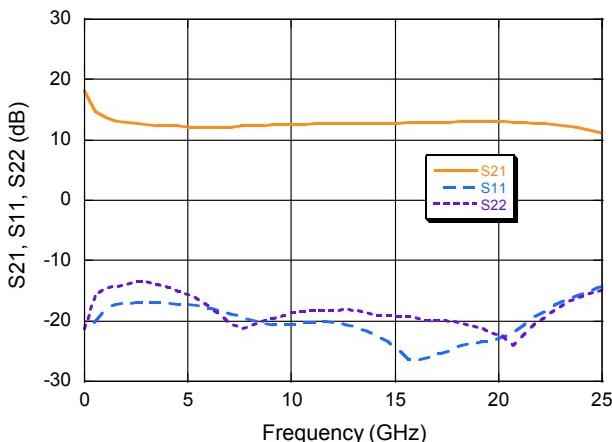
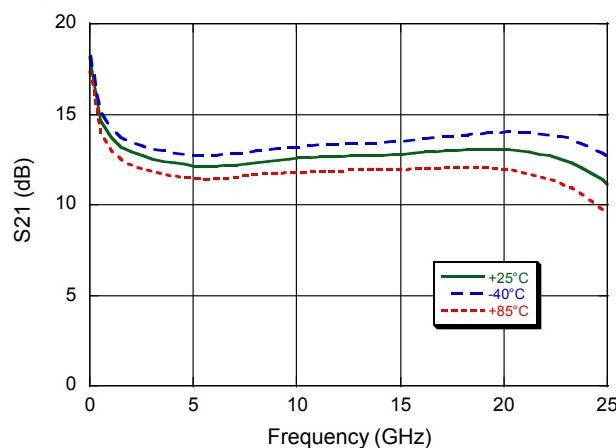
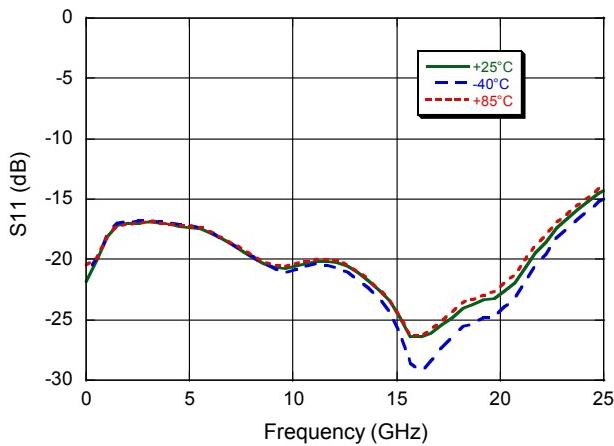
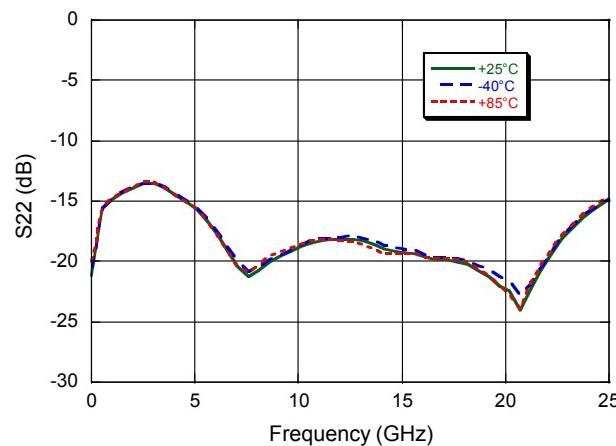
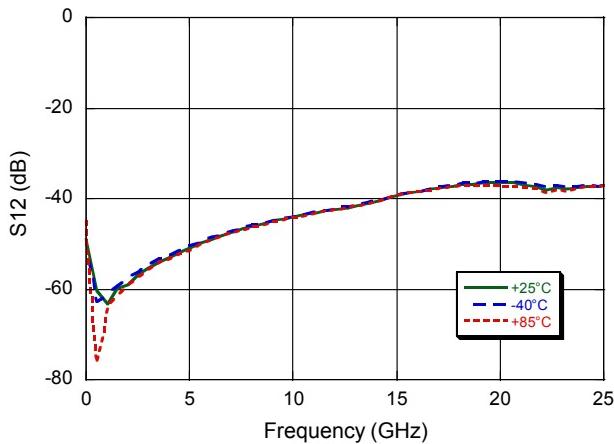
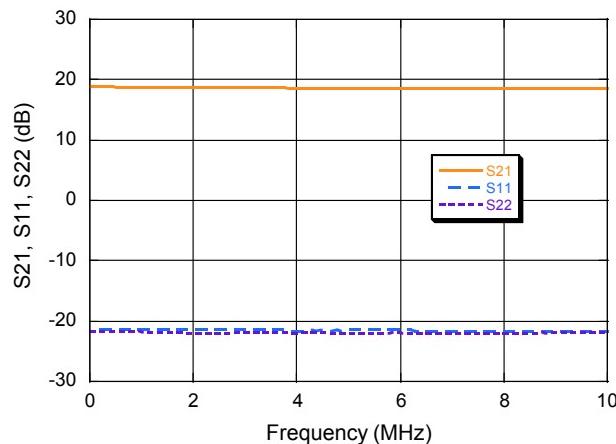
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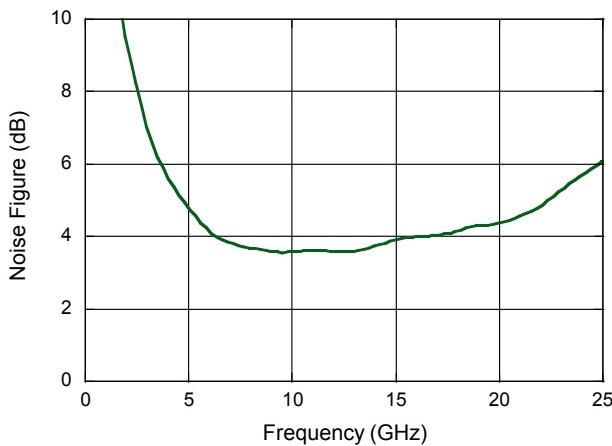
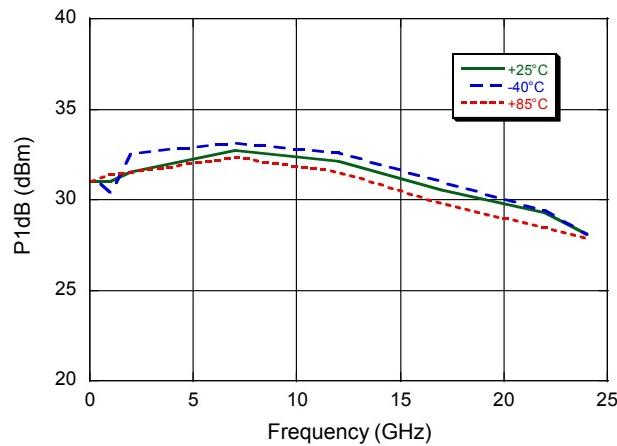
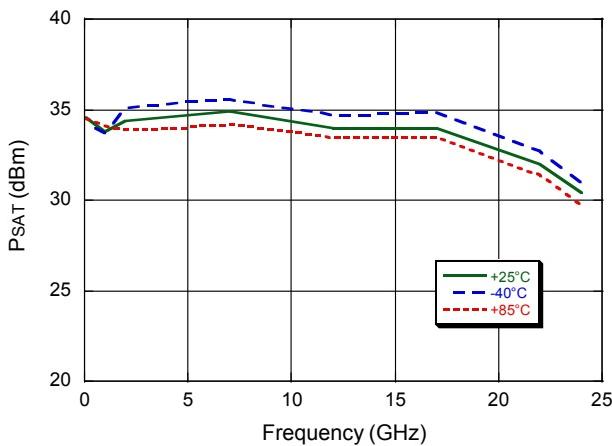
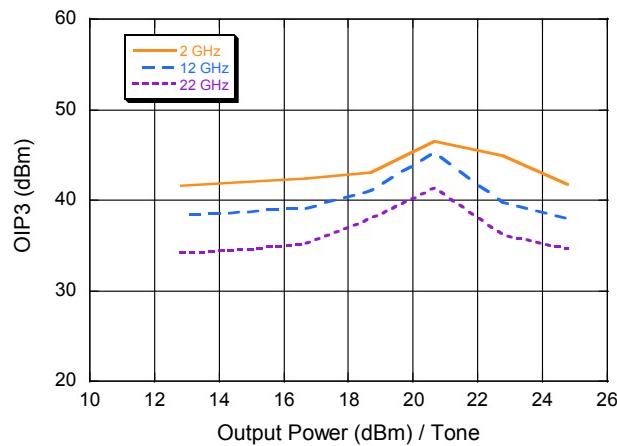
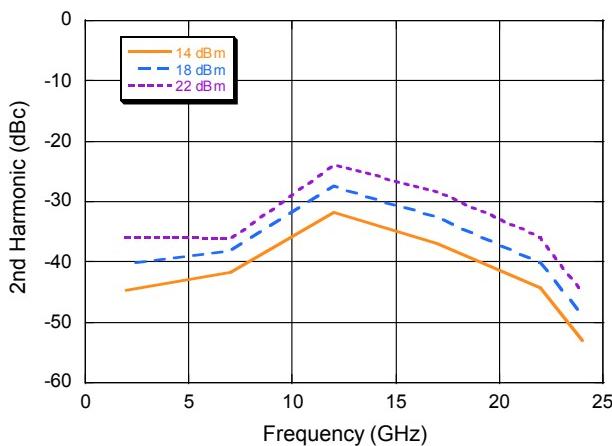
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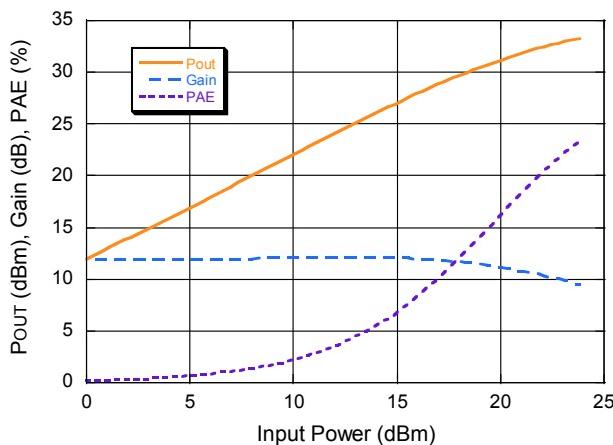
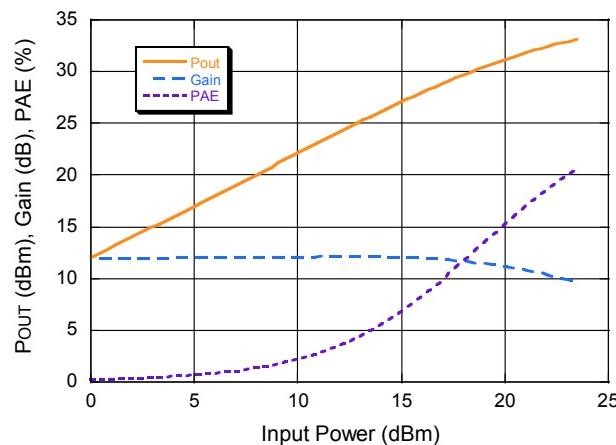
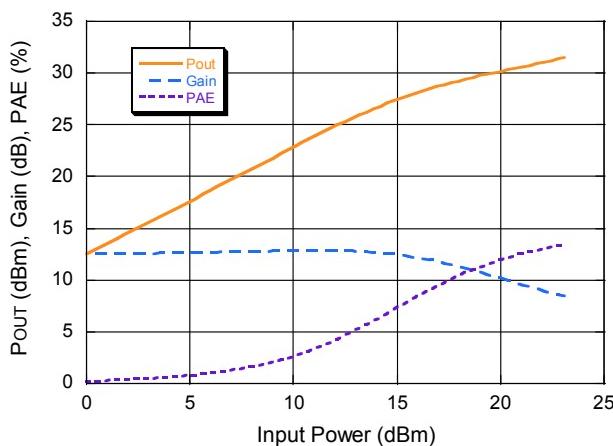
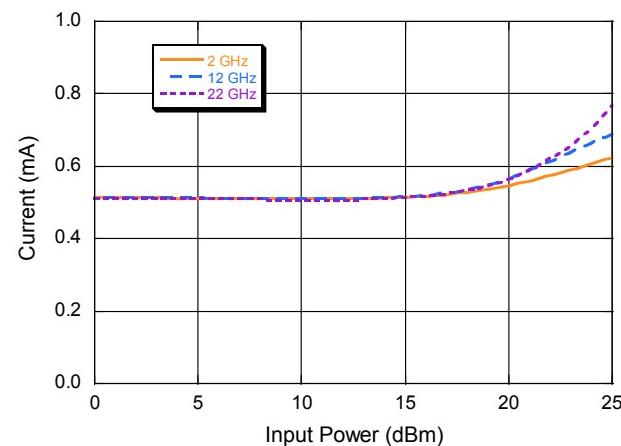
Preliminary - Rev. V2P**PCB Layout:**

RF input and output port pre-matching circuit patterns are designed to compensate bonding wires. Input and output matching are identical.



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Preliminary - Rev. V2P**Typical Performance Curves $V_{DD} = 15$ V, $I_{DSQ} = 500$ mA, $V_{G1} = -3.4$ V typical****S Parameters****Gain****Input Return Loss****Output Return Loss****Isolation****S Parameters @ Low Frequency**

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Preliminary - Rev. V2P**Typical Performance Curves $V_{DD} = 15$ V, $I_{DSQ} = 500$ mA, $V_{G1} = -3.4$ V typical****Noise Figure** **P_{1dB} over Temperature** **P_{SAT} over Temperature****Output IP3 vs. P_{OUT} / Tone****2nd Harmonic****Preliminary Information**

MAAP-011247-DIE**MACOM™**
**Power Amplifier, 2 W
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Preliminary - Rev. V2P**Typical Performance Curves $V_{DD} = 15$ V, $I_{DSQ} = 500$ mA, $V_{G1} = -3.4$ V typical****Power Compression @ 2 GHz****Power Compression @ 12 GHz****Power Compression @ 22 GHz****Current****Preliminary Information**

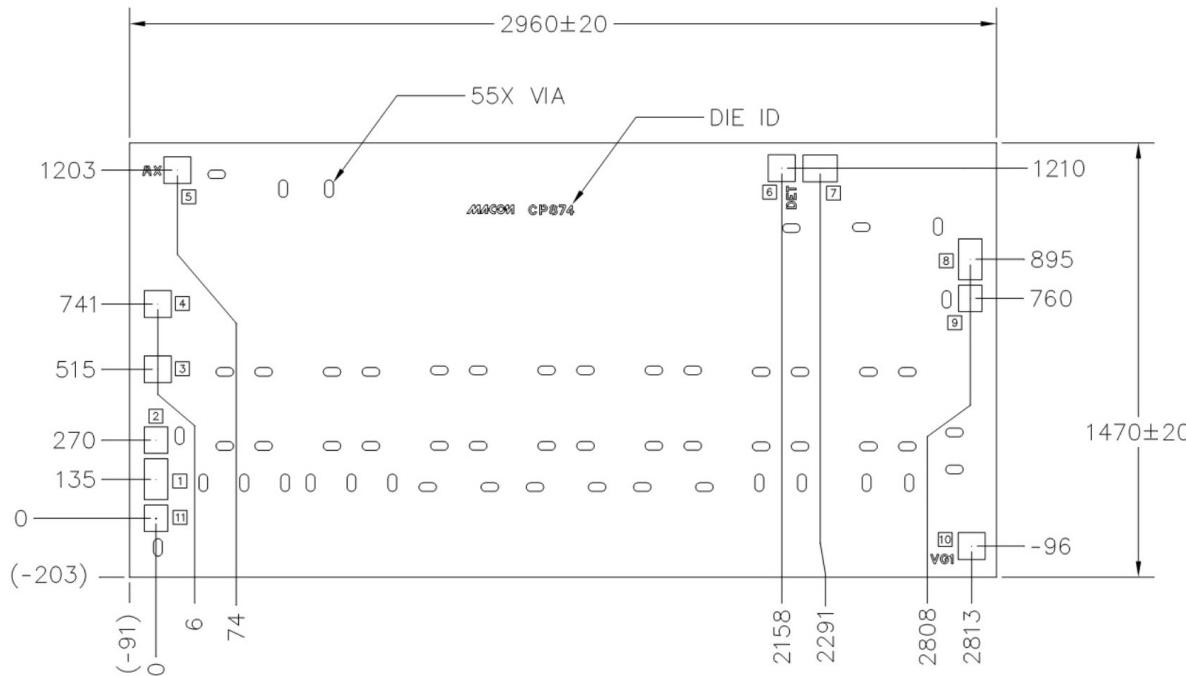
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Preliminary - Rev. V2P

MMIC Die Outline



Bond Pad Detail

| Pad | Size (x) | Size (y) |
|----------------|----------|----------|
| 1, 8 | 81 | 141 |
| 2, 9, 11 | 81 | 91 |
| 3, 4, 5, 6, 10 | 93 | 93 |
| 7 | 118 | 93 |

Notes:

13. All units in μm , unless otherwise noted, with a tolerance of $\pm 5 \mu\text{m}$.
 14. Die thickness is $100 \pm 10 \mu\text{m}$.

MAAP-011247-DIE

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Preliminary - Rev. V2P

Preliminary Information

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